Acta Mineralogica-Petrographica, Szeged, XXII/2, 311—337, 1976

NEWLY RECORDED AGGLUTINATED FORAMINIFERA FROM THE QUSSEIR SHALES IN GEBEL DUWI AND ABU HAD, EASTERN DESERT, EGYPT

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ABSTRACT

This paper describes and illustrates 45 agglutinated foraminiferal species recorded, for the first time, from the Qusseir Shales in Gebel Abu Had and Duwi, Eastern Desert, Egypt. Through the analysis of the reported fauna, 4 agglutinated zones were proposed and defined. On the basis of these biozones, the age of the Qusseir Shales is assigned to Campanian and Maestrichtian.

INTRODUCTION

The Qusseir Shales are a series of greyish green to dark grey, laminated shales alternating with yellowish and brownish ferruginous fine-grained sandstone beds.

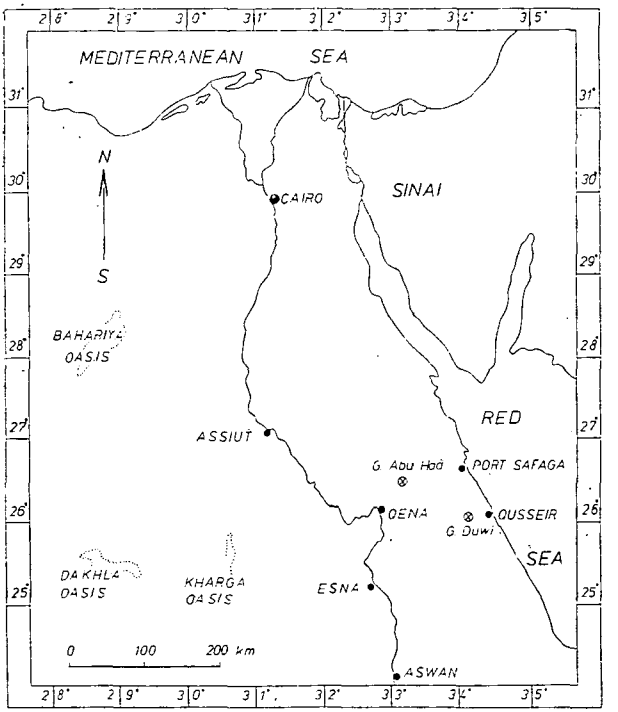

Fig. 1. Location Map

These shales were first described in detail by YOUSSEF (1949) in Qusseir district and were referred by him as "Variegated Clays". The same author (1957) named these shales as "Kosseir variegated shales" and described them as a multicoloured member that overlaines the "Nubia sandstone" and marked above by the appearence of the lowermost phosphate beds (Duwi Formation).

Ghorab (1956) considered the thick succession of variegated shales in Qusseir area as a separate formation which he named as "Qusseir Formation", with its type locality in Gebel Duwi, Red coast.

EL NAGGAR (1970) raised the Nubia sandstone to a group status. The Nubia group was suggested by this author to include, besides the dominating arenaceous units, the overlaying variegated shales (Qusseir Shales) as well as the following phosphate succession (Sibaiya Formation).

The Qusseir Shales have a wide horizontal extent in Egypt. These have been described from such widely separated areas in Egypt, as Dakhla, Kharga Oases to the west, the Nile Valley and the Qusseir Safage to the east, even from Central Sinai *(Fig. 1)*.

BIOSTRATIGRAPHY

The age of the Qusseir Shales was subject of a great controversy in the Egyptian stratigraphy for a long time ago, since they are devoid of mega- and microfossils that can detect the age definitely.

BLANCKENHORN (1900), STROMER and WELLAR (1930), ZDANSKY (1934) have identified the following *Vertebrate* fauna from the bone bearing ferruginous brecciated beds intercaleted the variegated shales in Mahamid district: *Schizonia stromeri, Plethodus* sp., *Amoedus angustus, Suchodus lybicus*. They considered these fossils to be of Upper Cretaceous and most probably Upper Senonian.

According to YOUSSEF (1957) this formation is of "probable Campanian age".

FARIS and HASSAN (1959) separated and identified a rich *Ammonite* fauna from the upper part of similar shales in Safage area. In their opinion these shales may have an age older than the Maestrichtian.

AWAD and GHOBRIAL [1965] considered the lowest fossiliferous zones of the Phosphate Formation, in El Kharga Oasis, to be of Lower Maestrichtian age, and the variegated shales to be prae-Maestrichtian.

ABDEL RAZIK (1966, 1967) found also these bands of bone beds intercalating the lower part of the variegated shales in the area between Idfu and Quena and assigned a Campanian age to these. The same author regarded the variegated shales in Gebel Anz, Qusseir area to be of Campanian age and at least its upper part is of Lower Maestrichtian.

EL NAGGAR (1966) recorded some *Vertebrate* species from the bone bed intercalating the shales in Gabal Nagaa El Sheikh. Zhis author considered the Nubia sandstone and variegated shales to be of Campanian and prae-Campanian age.

HERMINA (1967) considered the variegated shales are definitely Lower Maestrichtian in the north-western approaches of El Kharga Oasis, Western Desert, Egypt.

The present work is the first which determines the biostratigraphic age of the Qusseir Shales on micropaleontological basis. For this purpose about 50 samples were collected from this formation at Gebel Abu Had and Gebel Duwi (the type locality of this formation). These samples are rich in agglutinated smaller *Foraminifera*.

The Qusseir Shales Formation is subdivided into 4 biozones according to its

agglutinated foraminiferal content, in Abu Had and Duwi sections *(Figs. 2 and 3)* they are from base to top:

1. *Ammodiscus mangusi* Zone
2. *Trochammina undulosa* Zone
3. *Lituola difformis—taylorensis* Zone
4. *Ammobaculites khargensis* Zone

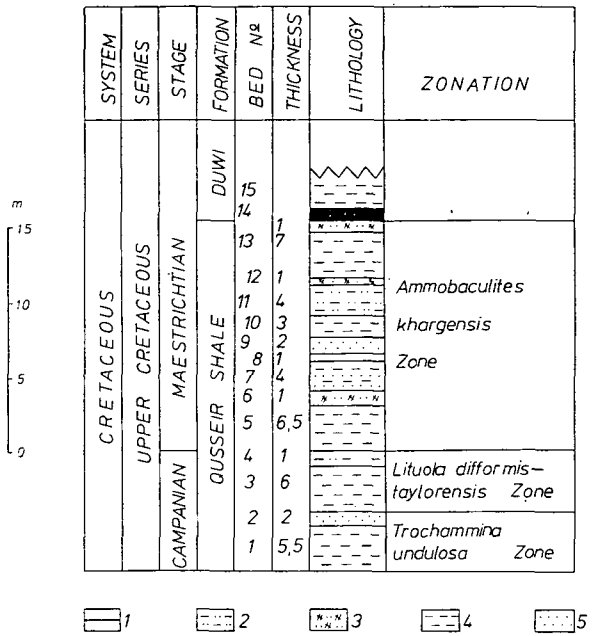

Fig. 2. Agglutinated foraminiferal zonation of Qusseir (variegated) shale at Gebel Abu Had section, Qena region
1. Phosphate. — *2.* Arenaceous shale. — *3.* Ferruginous sanstone. — *4.* Shale. — *5.* Sandstone.

1. *Ammodiscus mangusi* Zone

Occurrence: This zone is represented by the lowermost part of the Qusseir Shale of Duwi section, and not recorded in the Abu Had section.

Definition: The zone is defined by the first appearance and abundance of *Ammodiscus mangusi* (TAPPAN).

Description and faunal content: Lithologically, this zone (about 12 m in thickness) is composed mainly of pale grey shale and sandstone. The additional foraminiferal assemblage is as follows: *Glomospirella gaultina* (BERTHELIN), few specimens of *Ammodiscus glabratus* CUSHMAN ET WATERS, *Haplophragmoides gracilis* SAID ET KENAWY.

2. *Trochammina undulosa* Zone

Occurrence: It is represented by the lower part of the Qusseir Shales of Abu Had and Duwi sections.

Definition: The zone is defined by the first appearance and abundance of *Trocham-*

mina undulosa SCHIJFSMA and the absence of *Lituola difformis* LAMARCK and *L. taylorentis* CUSHMAN ET WATERS.

Description and faunal content: Lithologically this zone (about 7,5 m in thickness) is composed mainly of pale grey shales and sandstones and represents the lower part of the Qusseir Shales. The additional foraminiferal assemblage is as follows: *Trochammina borealis* KELLER, *Tr. ruthven-murrayi* CUSHMAN ET RENZ, *Tr. rainwateri* CUSHMAN ET APPLIN, *Tr. ribstonensis* WICKENDEN, *Tr. webbi* STELCK, *Tr. wickendeni* LOEBLICH, *Tr. gyroides* CUSHMAN ET WATERS and *Tr. texana* CUSHMAN ET WATERS.

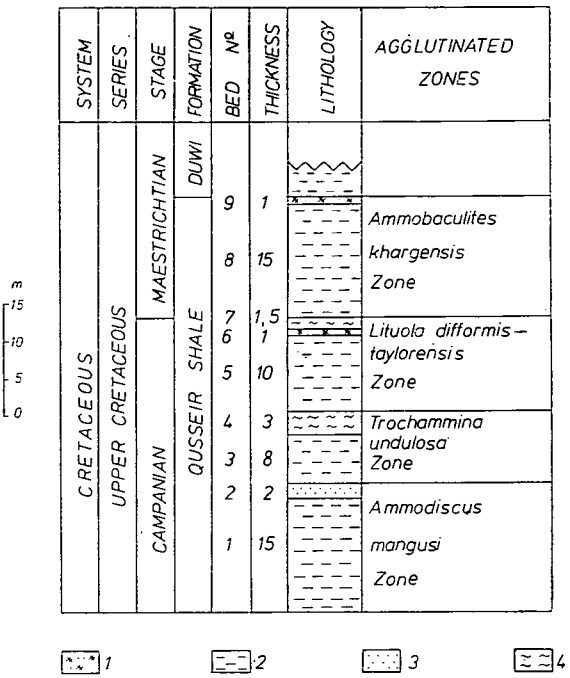

Fig. 3. Agglutinated foraminiferal zonation of the Qusseir (variegated) shale at Gebel Duwi, Qusseir district
1. Ferruginous sandstone. — *2.* Shale. — *3.* Sandstone. *4.* Marl.

3. *Lituola difformis—taylorensis* Zone

Occurrence: This zone represents the middle part of the Qusseir Shales of Abu Had and Duwi sections.

Definition: The zone is defined by the first appearance of *Lituola difformis* LAMARCK and *L. taylorensis* CUSHMAN ET WATERS which occurs in large numbers.

Description and faunal content: Lithologically, this zone is represented by shales and argillaceous shales. Other species were also recognized, such as: *Haplophragmoides glabra* CUSHMAN ET WATERS, *H. gracilis* SAID ET KENAWY, *H. rugosa* CUSHMAN ET WATERS, *H. sewellensis* OLSSON, *H. calculus* CUSHMAN ET WATERS, *Lituola obscura* BARNARD ET BANNER.

4. *Ammobaculites khargensis* Zone

Occurrence: It is represented in the upper part of the Qusseir Shales of Abu Had und Duwi sections.

Definition: The zone is distinguished by the first appearance of *Ammobaculites khargensis* NAKKADY ET TALAAT overlying the *Lituola difformis—taylorensis* Zone.

Description and faunal content: The zone (total thickness about 30,5 m) is mainly composed of shales, arenaceous shales, and argillaceous sandstone. Other faunal element met with are: *Ammobaculites colombiana* CUSHMAN ET HEDBERG, *A. stephensoni* CUSHMAN, *A. alexanderi* CUSHMAN, *A. advenus* CUSHMAN ET APPLIN, *A. agrestis* CUSHMAN ET APPLIN, *A. rowei* BANNER, *A. esnehensis* var. *nudus* NAKKADY, *Haplophragmium compressum* BEISSEL.

AGE ASSIGNMENT

The lower and the middle parts of the Qusseir Shales in the studied areas include the zones of *Ammodiscus mangusi,* the *Trochammina undulosa* and the *Lituola difformis—taylorensis*, respectively.

The characteristic species of these zones were firstly described from the Campanian sediments of France, USA, Canada and in other parts of Egypt. Therefore, the present authors incline to assigne a Campanian age to the lower and middle part of the Qusseir Shales.

The faunal assemblage of the *Ammobaculites khargensis* Zone is to correlate with similar ones in Egypt and other parts of the world, and it is referred to the Maestrichtian age.

SYSTEMATIC DESCRIPTION

Ordo: *Foraminifera* EICHWALD, 1830
Subordo: Textulariina DELAGE ET HEROUARD, 1896
Superfamily: *Ammodiscacea* REUSS, 1862
Family: Rzehakinidae CUSHMAN, 1933
Subfamily: Rzehakininae CUSHMAN, 1933
Genus: *Miliammina* HERON-ALLEN ET EARLAND, 1930

Miliammina awunensis TAPPAN

PLATE I, *Figs. 13—14*

Miliammina awunensis TAPPAN (1957, p. 210; Pl. 67, *Figs. 19—21*)

Remarks: This species is characterized by somewhat large test with thicker chambers, and with finely agglutinated wall and smoothly finished exterior. Length 0,23 mm, width 0,17 mm.

Occurrence: Miliammina awunensis was previously described from the Cretaceous Grandstand Formation (Turonian) in Northern Alaska. In the present study, it is recorded from the lower part of Qusseir Shales.

Miliammina bisobscura STELCK ET WALL

PLATE I, *Fig. 12;* PLATE V, *Fig. 3*

Miliammina bisobscura STELCK ET WALL (1954, p. 29; Pl. 1, *Figs. 1—2*)

Remarks: The species is chracterized by compressed subelliptical test, chambers in alternating cyclic arrangement, and simple aperture. Length 0,30 mm, width 0,17 mm.

Occurrence: This species was first described from the Kaskapaw Formation (Lower Turonian) in Canada. It occurs mainly in the lower part of the Qusseir Shales.

Family: Ammodiscidae REUSS, 1862
Subfamily: *Ammodiscinae* REUSS, 1862
Genus: *Ammodiscus* REUSS, 1862

Ammodiscus glabratus CUSHMAN ET JARVIS

PLATE I, *Figs. 10—11*

Ammodiscus glabratus CUSHMAN ET JARVIS (1928, p. 86; Pl. 12, *Fig. 6*)

Remarks: This species has a thin agglutinated wall with considerable amount of siliceous cement producing a smooth surface. The figured specimen measures 0,4 mm in diameter and 0,03 mm in thickness.

Occurrence: CUSHMAN nad JARVIS first described this species from the Lizard Springs in Trinidad (Late Meastrichtian). It occurs mainly in the upper part of the Qusseir Shales.

Ammodiscus mangusi (TAPPAN)

PLATE I, *Figs. 7—9*

Involutina mangusi TAPPAN (1957, p. 203; Pl. 65, *Figs. 13—14*)

Remarks: Test free, discoidal, consisting of proloculus and long, undivided, planispiral, evolute second chamber, which is relatively thick and forms only a few whorls. Specimens commonly compressed in preservation. Wall finely to moderately coarsely agglutinated; aperture at the open end of the tubular chamber. It is characterized by a more evenly planispiral, and it is not so irregularly coiled in the early stages as *A. gaultinus.*

Occurrence: This species was found in the Topaguruk and Grandstand Formation. It occurs mainly in the lower part of the Qusseir Shales, too.

Genus: *Glomospira* RZEHAK, 1888

Glomospira irregularis (GRZYBOWSKI)

PLATE I, *Fig. 2*

Ammodiscus irregularis GRZYBOWSKI (1898, p. 285; Pl. 11. *Figs. 2—3*). — *Glomospira irregularis* (GRZYBOWSKI): GLAESSNER (1937, p. 359; Pl. 1, *Fig. 7;* POKORNÝ (1958, pp. 11—12; *Text-fig. 3*).

Remarks: This species is characterized by rough surface, highly irregular coiling of the tubular chamber. Wall consists of fine-grained quartz with siliceous cement. Diameter 0,4 mm to 0,9 mm.

Occurrence: GRZYBOWSKI described this species from the Upper Cretaceous of the Polish Carpathians (beds with *Inoceramus*). It was found by us in the Gebel Duwi section, in the *Ammodiscus mangusi* Zone. Age: Campanian.

Glomospira serpens (GRZYBOWSKI)

PLATE I, *Figs, 3—4:* PLATE IV, *Figs. 11—12*

Ammodiscus serpens GRZYBOWSKI (1898, p. 285; Pl. 10, *Figs. 31—33*). — *Glomospira serpens* (GRZYBOWSKI): GEROCH (1962, p. 47; Pl. 4, *Fig. 13*).

Remarks: The test of this species is smooth, its tubular chamber elliptically coiled (2—3 coils). Wall consists of fine quartz grains with siliceous cement. Diameter 0,8 mm to 1 mm.

Occurrence: It was first described from the Upper Cretaceous of the Polish Carpathians (beds with *Inoceramus*). In our sections, it was identified from the *Ammodiscus mangusi* Zone. — Age: Campanian.

Genus: *Glomospirella* PLUMER, 1945
Glomospirella gaultina (BERTHELIN)

PLATE I, *Figs. 5—6*

Ammodiscus gaultinus BERTHELIN (1880, p. 19; Pl. 1, *Fig. 3a—b*). — LOEBLICH AND TAPPAN 1964, p. 95; Pl. 14, *Fig. a—c*). — FRIZZEL (1954, p. 58; Pl. 4, *Fig. 17a—c*). — *Glomospirella gaultina* (BERTHELIN): TAPPAN (1962, p. 130; Pl. 29. *Figs. 17—20*).

Remarks: This species is characterized by shell of small size (diameter 0,24—0,30 mm), and rounded outline. The tubular chamber coiled in 5 coils. Spiral suture slightly depressed. Wall agglutinated, fine-grained, and 0,012 mm in thickness.

Occurrence: It was described by BERTHELIN (1880) from the Cretaceous of France. In the present study, it is recorded from the Qusseir Shales of G. Duwi (lower part). — Age: Campanian.

Superfamily: *Lituolacea* BLAINVILLE, 1825
Family: Hormosinidae HAECKEL, 1894
Subfamily: Hormosininae HAECKEL, 1894
Genus: *Proteonina* WILLIAMSON, 1858

Proteonina complanata FRANKE

PLATE I, *Fig. 1*

Proteonina complanata FRANKE (1914, p. 431; Pl. 27, *Figs. 1—2*).

Remarks: It is characterized by a flattened test and siliceous agglutinated wall consisting of finely cemented quartz grains, ranged in size from 0,03 to 0,005 mm, with a large amount of cement. Lenght 0,50 mm, breadth 0,33 mm, thickness 0,03 mm.

Occurrence: FRANKE (1914) recorded this species from the Upper Cretaceous (Campanian) of Germany. The present writers identified it from the Qusseir Shales.

Family: Lituolidae BLAINVILLE, 1825
Subfamily: Haplophragmoidinae MAYNC, 1952
Genus: *Haplophragmoides* CUSHMAN, 1910

Haplophragmoides calculus CUSHMAN ET WATERS

PLATE I, *Figs. 17—18*; PLATE IV, *Fig. 15;* PLATE VII, *Fig. 2*

Haplophragmoides calculus CUSHMAN ET WATERS (1927, p. 83; Pl. 10, *Fig. 5*). — FRIZZEL (1954, p. 59; Pl. 1, *Figs. 26a—b*).

Remarks: The species is characterized by a simple wall, increasing in thickness from 0,02 to 0,09 mm, and composed of quartz grains ranging in size from 0,01 to 0,08 mm. Length 0,79 mm; thickness 0,17 mm.

Occurrence: It was first described from the Navarro Formation (Maestrichtian) in Texas. It occurs in the upper Qusseir Shales, too.

Haplophragmoides glabra CUSHMAN ET WATERS

PLATE II, *Fig. 1;* PLATE IV. *Fig. 14*

Haplophragmoides glabra CUSHMAN ET WATERS (1927, p. 83; Pl. 10, *Fig. 6*).

Remarks: The species is characterized by a finely agglutinated wall, gradually increased in thickness from 0,02 to 0,03 mm, and composed of quartz grains ranged in size from 0,005 to 0,01 mm. Length 0,50 mm, width 0,43 mm, thickness 0,17 mm.

Occurrence: It was first identified from the Navarro Formation (Maestrichtian) in Texas. It occurs in the upper Qusseir Shales, too.

Haplophragmoides glomeratoformis ZASPYELOVA

PLATE V, *Fig. 1*

Haplophragmium glomeratum (BRADY): CHAPMAN (1892, p. 321; Pl. 5, *Fig. 8*); fide ELLIS AND MESSINA (1940). — *Haplophragmoides glomeratoformis* ZASPYELOVA (1948, p. 197; Pl. 1, *Figs. 4a—b*).

Remarks: Test planispiral, rounded. Peripheral margin rounded and lobate. In the final whorl there are four five inflated chambers varying in shape from irregularly oval to spherical. Sutures depressed, straight or very weakly curved. Aperture indistinct. Wall moderately grained.

Occurrence: This species was recorded by ZASPYELOVA (1948) from the Upper Cretaceous of the West-Siberian Lowland. In Egypt, it was found in the *Lituola difformis—taylorensis* Zone of the Qusseir Shales in the Gebel Abu Had and Duwi sections.

Haplophragmoides gracilis SAID ET KENAWY

PLATE *I, Fig. 19*

Haplophragmoides gracilis SAID ET KENAWY (1957, p. 78; Pl. 13, *Fig. 1*).

Remarks: This species is characterized by a simple wall, finely agglutinated, gradually increased in thickness from 0,01 to 0,02 mm, and composed of quartz grains ranging in size from 0,005 to 0,01 mm, with a considerable amount of ferruginous material and little amount of siliceaous cement. Diameter 0,33 mm; thickness 0,03 mm.

Occurrence: The species was previously identified from the Turonian succession in Abu Roash area. In the present study it is recorded from the lower part of the Qusseir Shales.

Haplophragmoides kirki WICKENDEN

PLATE II, *Fig. 5;* PLATE V, *Fig. 5;* PLATE VI, *Fig. 4*

Haplophragmoides kirki WICKENDEN (1932, p. 85; Pl. 1, *Fig. 1*).

Remarks: The species is characterized by its simple wall, about 0,04 mm in thickness, and composed of quartz grains ranging in size from 0,004 to 0,04 mm Diameter 0,4 mm; thickness 0,3 mm.

Occurrence: This species was firstly recorded from the Upper Cretaceous Bear-paw Shale in Canada. It occurs in the Qusseir Shales, too.

Haplophragmoides rota NAUSS

PLATE I, *Figs. 15—16;* PLATE VI, *Fig. 3*

Haplophragmoides rota NAUSS (1947, p. 339; Pl. 49, *Figs. 1, 3*).

Remarks: The species is characterized by a simple wall, coarsely agglutinated, increasing in thickness from 0,03 to 0,07 mm and composed of quartz grains ranging in size from 0,01 to 0,06 mm, with considerable amount of siliceous cement. Diameter 0,26 mm; thickness 0,20 mm.

Occurrence: The species was firstly described from the Late Cretaceous sediment in Alberta, Canada. It occurs mainly in upper part of the Qusseir Shales.

Haplophragmoides rugosa CUSHMAN ET WATERS

PLATE IV, *Fig. 13*

Haplophragmoides rugosa CUSHMAN ET WATERS (1927, p. 83; Pl. 19, *Fig. 4*).

Remarks: Test close-coiled, planispiral, deeply umbilicate; periphery broadly rounded. Sutures slightly depressed radially. Wall coarsely agglutinated.

Occurrence: This species was described by Cushman and Waters from the Navarro group of Texas (Maestrichtian. We found it in the *Lituola difformis—taylorensis* Zone of the Qusseir Shales in the Abu Had and Duwi sections.

Haplophragmoides sewellensis OLSSON

PLATE II, *Fig. 3*

Haplophragmoides sewellensis OLSSON (1960, p. 5; Pl. 1, *Figs. 1—2*).

Remarks: This species is characterized by its small size and finely agglutinated wall. Diameter 0,17 mm; thickness 0,07 mm.

Occurrence: The species was previously reported from the Late Maetrichtian sediments of New Jersey. It occurs in the upper part of the Qusseir Shales.

Haplophragmoides spiritensis STELCK ET WALL

PLATE II, *Fig. 2;* PLATE VI; *Fig. 5*

Haplophragmoides spiritensis STELCK ET WALL (1954, p. 28; Pl. 2, *Figs. 7—9*).

Remarks: It is characterized by a simple wall, finely agglutinated, increasing in thickness from 0,01 to 0,02 mm, and composed of quarts grains ranging in size from 0,005 to 0,02 mm, with considerable amount of ferrugimous material and siliceous cement producing a smoothly finished surface. Diameter 0,43 mm; thickness 0,10 mm.

Occurrence: The species was previously described from the Kaskapau Formation (Lower Turonian) in Canada. It occurs in the lower part of the Qusseir Shales at Gebel Abu Had.

Genus: *Cribrostomoides* CUSHMAN, 1910

Cribrostomoides cretacea CUSHMAN ET GOUDKOFF

PLATE II, *Fig. 10*

Cribrostomoides cretacea CUSHMAN ET GOUDKOFF (1944, p. 54; Pl. 9, *Fig. 4*).

Remarks: The species is characterized by its finely agglutinated wall and smoothly finished exterior. Length 0,69 mm, width 0,4 mm, thickness 0,23 mm.

Occurrence: It was firstly recorded from the Upper Cretaceous beds in California. It occurs in the upper Qusseir Shales of the Abu Had section, too.

Subfamily: Lituolinae BLAINVILLE
Genus: *Lituola* LAMARCK, 1804

Lituola difformis LAMARCK

PLATE II, *Fig. 14*

Lituola difformis LAMARCK (1804, 5, pp. 242—245; Pl. 14). — MAYNC (1952, pp. 37, 38, 47; Pl. 10. *Figs. 1—6*).

Remarks: The species is characterized by a simple wall, gradually increasing in thickness from 0,02 to 0,05 mm, and composed of quartz grains ranging in size from 0,01 to 0,05 mm. Length 0,6 mm, width 0,46 mm, thickness 0,27 mm.

Occurrence: It was firstly described from the Meduon beds (Campanian) in France. It occurs in the Qusseir Shales of both Abu Had and Duwi.

Lituola taylorensis CUSHMAN ET WATERS

PLATE II, *Fig. 16*

Lituola taylorensis CUSHMAN ET WATERS (1929, p. 66; Pl. 10, *Fig. 7*).

Remarks: This species is characterized by a simple wall, coarsely arenaceous, with large amount of cement. Length 0,83 mm, width 0,50 mm, thickness 0,14 mm.

Occurrence: It was firstly described from the upper Taylor marl (Campanian) in Texas. It occurs in the Qusseir Shales of both Abu Had and Duwi.

Lituola obscura BARNARD ET BANNER

PLATE II, *Fig. 4*

Lituola obscrura BARNARD ET BANNER (1953, p. 181; Pl. 7, *Fig. 7*).

Remarks: It is characterized by a large size, coarsely agglutinated simple wall with small amount of cement. Length 0,9 mm, width 0,65 mm, thickness 0,17 mm.

Occurrence: First record from the Upper Senonian—Lower Maestrichtian sediments of Norfolk, England. It was found in the upper part of the Qusseir Shales of Abu Had section.

Genus *Ammobaculites* CUSHMAN, 1910

Ammobaculites advenus CUSHMAN ET APPLIN

PLATE II, *Fig. 9;* PLATE VI, *Fig. 2*

Ammobaculites advenus CUSHMAN ET APPLIN (1947, p. 53; Pl. 13, *Fig. 1*)

Remarks: The species is characterized by its simple wall coarsely agglutinated, composed of quartz grains ranging in size from 0,06 to 0,01 mm, with little amount of siliceous cement. Length 0,69 mm; width 0,56 mm; thickness 0,10 mm.

Occurrence: Ammobaculites advenus was firstly described from the Upper Cretaceous sediments in Texas. In the present study, this species occurs aboundantly in the Qusseir shales in Gebel Duwi.

Ammobaculites agrestis CUSHMAN ET APPLIN

PLATE II, *Fig. 15;* PLATE VII, *Fig. 1*

Ammobaculites agrestis CUSHMAN ET APPLIN (1947, p. 53; Pl. 13, *Figs. 2—3*) — FRIZZELL (1954, p. 61; Pl. 2, *Figs. 10a—b*)

Remarks: This species is characterized by a simple wall, decreasing in thickness from 0,05 to 0,03 mm, and composed of quartz grains ranging in size from 0,04 to 0,2 mm. Length 0,56 mm; width 0,39 mm; and thickness 0,13 mm.

Occurrence: Ammobaculites agrestis was previously reported from the Campanian beds in Texas. It occurs mainly in the Qusseir shales of Abu Had section.

Ammobaculites alexanderi CUSHMAN

PLATE III, *Fig. 1*

Ammobaculites alexanderi CUSHMAN (1933, p. 51; Pl. 5. *Fig. 5*)

Remarks: This species is characterized by its elongate test and coarsely agglutinated wall. Length 0,43 mm, width 0,20 mm, and thickness 0,15 mm.

Occurrence: This species was firstly recorded from the Campanian in Texas. It occurs commonly in the Qusseir shales of Gebel Duwi.

Ammobaculites colombiana CUSHMAN ET HEDBERG

PLATE III, *Fig. 3;* PLATE VII, *Fig. 4*

Ammobaculites colombiana CUSHMAN ET HEDBERG (1930, p. 68; Pl. 9, *Fig. 4*)

Remarks: Ammobaculites colombiana is characterized by a simple arenaceous agglutinated wall, about 0,02 mm in thickness and composed of quartz grains ranging in size from 0,05 to 0,01 mm, with considerable amount of siliceous cement. Length 0,36 mm; width 0,30 mm.

Occurrence: This species was firstly described from the Upper Cretaceous beds in Colombia. It is identified mainly from the Qusseir shales of Gebel Duwi.

Ammobaculites esnehensis var. *nudus* NAKKADY

PLATE II, *Fig. 6*

Ammobaculites esnehensis var. *nudus* NAKKADY (1949, pp. 221, 234, 240; 1950, p. 683; Pl. 83, *Fig. 3*)

Remarks: This species is characterized by its small size, finely agglutinated wall with a considerable amount of cement resulting a smoothly finished surface. Length 0,50 mm; diameter of coiled portion 0,33 mm.

Occurrence: It was previously reported from the Dakhla Shales of Sinai. The species occurs also in the Qusseir shales of Gebel Duwi.

Ammobaculites khargensis NAKKADY ET TALAAT

PLATE III, *Fig. 14;* PLATE V, *Fig. 4*

Ammobaculites khargensis NAKKADY ET TALAAT (1959, p. 456; Pl. 6, *Figs. 1a—b, 2a—b*)

Remarks: The species is characterized by its large size and more coarsely agglutinated wall with considerable amount of siliceous cement. Length 1,5 mm; width 1,2 mm; thickness 0,21 mm.

Occurrence: NAKKADY ET TALAAT (1959) indetified this species from the *Exogyra* bed and Kharga Shale member in Gebel Umm el Ghanayem. It occurs only in the upper levels of the Qusseir shales in Abu Had and Duwi sections.

Ammobaculites stephensoni CUSHMAN

PLATE II, *Fig. 8*

Ammobaculites stephensoni CUSHMAN (1933, p. 49; Pl. 5, *Fig. 2*) — FRIZZELL (1954, p. 62; Pl. 2, *Figs. 26a—b*)

Remarks: The species is characterized by coarsely arenaceous wall, increasing in thickness from 0,02 to 0,08 mm; with a little amount of ferruginous materials. Length 0,79 mm; width 0,59 mm; thickness 0,17 mm.

Occurrence: It was first drecribed from the Taylor marl (Campanian) in Texas It occurs abundantly in the upper parts in the Qusseir shales in Abu Had section, in the *Ammobaculites khargensis* Zone.

Ammobaculites rowei BANNER

PLATE III, *Fig. 2*

Ammobaculites rowei BANNER (1953, p. 180; Pl. 7, *Fig. 6*).

Remarks: The uniserial portion is sometimes irregularly curved. Wall agglutinated, thick, rugose, composed of fine quartz grains with siliceous cement. Length 0,68 mm; width 0,56 mm; thickness 0,15 mm.

Occurrence: The species was recorded from the Lower Coniacian sediments near Seaford Head, Sussex, England. In the present study, this species was identified from the *Ammobaculites khargensis* Zone of the Abu Had and Duwi sections.

Ammobaculites comprimatus CUSHMAN ET APPLIN

PLATE II, *Fig. 7*

Ammobaculites comprimatus CUSHMAN ET APPLIN (1946, p. 73; Pl. 13, *Fig. 3*)

Remarks: Chambers increasing in size as added. Sutures are distinct. Wall agglutinated, finegrained, producing a smooth surface. Length 0,65 mm; width 0,50 mm; thickness 0,18 mm.

Occurrence: This species was firstly described from the Upper Cretaceous and upper part of the Woodbine Formation (Cenomanian) in Texas. It was rarely recorded from the upper level of the Qusseir shales of Abu Had and Duwi sections *(Ammobaculites khargensis* Zone).

Genus *Ammobaculoides* PLUMMER, 1932

Ammobaculoides plummerae LOEBLICH

PLATE II, *Fig. 13*

Ammobaculoides plummerae LOEBLICH (1946, p. 137; Pl. 22, *Figs. 10—12*)

Remarks: The species is characterized by its simple agglutinated wall, about 0,03 mm in thickness, with large amount of siliceous cement. Length 0,60 mm; width 0,25 mm; thickness 0,10 mm.

Occurrence: LOEBLICH (1946) firstly recorded this species from the Upper Cretaceous sediments in Texas. In the Eastern Desert, this species occurs in the *Ammobaculites khargensis* Zone of the Abu Had and Duwi sections.

Genus *Haplophragmium* REUSS, 1860

Haplophragmium compressum BEISSEL

PLATE II, *Fig. 11—12;* PLATE V, *Fig. 2*

Haplophragmoides compressum BEISSEL (1886, p. 138) — BEISSEL (1891, pp. 16—17; Pl. 4, *Figs. 11—23*)

Remarks: This species is characterized by a small and highly compressed test. Length 0,36 mm; diameter of coiled portion 0,17 mm.

Occurrence: Haplophragmium compressum was first described from Upper Cretaceous beds in Germany. It occurs mainly in the *Ammobaculites khargensis* zone (Maestrichtian).

Family: Textulariidae EHRENBERG, 1839
Subfamily: Spiroplectammininae CUSHMAN, 1927
Genus: *Spiroplectammina* CUSHMAN, 1927

Spiroplectammina bentonensis CARMAN

PLATE III, *Fig. 5—10;* PLATE VI, *Fig. 1*

Spiroplectammina bentonensis CARMAN (1929, p. 311; 34, *Figs. 8—9*)

Remarks: This species is characterized by slightly oblique sutures and finely agglutinated wall with much cement, producing smoothly finished surface. Length 0,33 mm; width 0,13 mm; thickness 0,07 mm.

Occurrence: The species was first described from the Upper Cretaceous Benton Shale (USA). This species occurs abundantly in the upper part of the Qusseir Shales (*Ammobaculites khargensis* zone) of Abu Had and Duwi sections.

Spiroplectammina tenuis GAUGER

PLATE III, *Fig. 11*

Spiroplectammina dentata (ALTH) var. *tenuis* GAUGER (1953, p. 59; Pl. 6, *Figs. 1, 1a, 2*)

Remarks: This species is characterized by limbate sutures, relatively compressed chambers extended into short processes, and finely agglutinated wall with much cement and smoothly finished exterior. Length 0,30 mm; width 0,13 mm; thickness: 0,03 mm.

Occurrence: It was firstly described from the. Upper Cretaceous beds of USA. It occurs mainly in the *Lituola difformis—taylorensis* Zone (Campanian) in the Abu Had and Duwi sections .

Family: Trochamminidae SCHWAGER, 1877
Subfamily: Trochammininae SCHWAGER, 1877
Genus: *Trochammina* PARKER ET JONES

Trochammina albertensis WICKENDEN

PLATE III, *Figs. 17—18*

Trochammina albertensis WICKENDEN (1932, p. 90; Pl. 1, *Figs. 9a—b*)

Remarks: This species is characterized by its finely agglutinated wall with much cement. Diameter 0,36 mm; thickness 0,07 mm.

Occurrence: WICKENDEN first recorded this species from the Upper Cretaceous Bearpaw Shale (Canada). In the studied sections it occurs in the *Lituola difformis—taylorensis* zone.

Trochammina altiformis CUSHMAN ET RENZ

PLATE IV, *Fig. 1—2*

Trochammina globigeriniformis PARKER ET JONES var. *altiformis* CUSHMAN ET RENZ (1946 p. 24; Pl. 3, *Figs. 7—11*)

Remarks: This species is characterized by a finely agglutinated wall with considerable amount of cement. Diameter 0,30 to 0,20 mm.

Occurrence: It was privously described from the Lizard Springs marl (Late Maestrichtian—Danian) in Trinidad. The species occurs mainly in the upper part of the *Ammobaculites khargensis* Zone in the Duwi and Abu Had sections.

Trochammina texana CUSHMAN ET WATERS

PLATE III, *Figs. 12—13*

Trochammina texana CUSHMAN ET WATESR (1927, *2*, p. 85; Pl. 11, *Figs. 8*)

Remarks: This species is characterized by very finely agglutinated wall and smoothly finished exterior. Diameter 0,42—0,45 mm.

Occurrence: Trochammina texana was firstly described from the Navarro Formation (Maestrichtian) in Texas. In Eastern Desert, this species occurs in the *Ammobaculites khargensis* (Maestrichtian) zone of the Quesseir shales in the Abu Had and Duwi sections.

Trochammina borealis KELLER

PLATE IV, *Figs. 5—6*

Trochammina borealis KELLER (1935, p. 38; Pl. 2, *Fig. 11a*)

Remarks: Trochammina borealis in characterized by the relative height of its spire, which is deviating from its type form; wall finely agglutinated with much siliceous cement. Diameter 0,35 to 0,40 mm.

Occurrence: This species was firstly described from the Upper Cretaceous white chalk of northern edge of the Dnjepr—Donetz Basin (USSR). It occurs in the *Tro-*

chammina undulosa Zone (Campanian) in the Qusseir Shales of the Abu Had and Duwi Sections.

Trochammina gyroides CUSHMAN ET WATERS

PLATE III, *Figs. 19—20*

Trochammina gyroides CUSHMAN ET WATERS (1927, p. 84; Pl. 10, *Fig. 8*)

Remarks: This species is characterized by subacute periphery, finely agglutinated wall, which is composed of fine quartz grains (0,01—0,02 mm in size) and siliceous cement. Diameter 0,28 to 0,32 mm.

Occurrence: Trochammina gyroides was first described from the Upper Cretaceous in Texas. This species identified from the *Trochammina undulosa* Zone (Campanian) in Gebel Abu Had section.

Trochammina rainwateri CUSHMAN ET APPLIN

PLATE III, *Fig. 21*

Trochammina rainwateri CUSHMAN ET APPLIN (1946 p. 75; Pl. 3, *Fig. 9*)

Remarks: The species is characterized by gradually and regularly increasing in size of chambers, wall finely agglutinated composed from fine quartz grains and ferruginous cement. Diameter 0,35 to 0,38 mm.

Occurrence: The species was firstly described from the upper part of the Woodbine Formation (Upper Cretaceous), Texas. It occurs in the *Trochammina undulosa* Zone (Campanian) of Abu Had and Duwi sections.

Trochammina ribstonensis WICKENDEN

PLATE IV, *Figs. 9—10*

Trochammina ribstonensis WICKENDEN (1932, p. 90; Pl. 1, *Figs. 12a—c*)

Remarks: Test very small with globular chambers and slightly curved, nearly radiate sutures; wall finely agglutinated, thin, composed of fine quartz grains with siliceous cement. Diameter 0,18 to 0,24 mm.

Occurrence: This species was first recorded from the Upper Cretaceous sediments, Alberta, Canada. It was recorded in the *Trochammina undulosa* Zone in the Qusseir Shales of Abu Had and Duwi sections.

Trochammina ruthven-murrayi CUSHMAN ET RENZ

PLATE IV, *Figs. 7—8*

Trochammina ruthven-murrayi CUSHMAN ET RENZ (1946, p. 24; Pl. 3, *Fig. 13*)

Remarks: The species somewhat resembles *Trochammina ribstonesis* WICKENDEN, but it much larger and more conical, the chambers at the dorsal side are more elongate and narrow, wall composed of fine-grained quartz (0,01—0,03 mm in size) with ferruginous cement.

Occurrence: It was first described from the Lizard Springs marls (USA). A rare number of this species was found in the *Trochammina undulosa* Zone (Campanian) in the Abu Had section.

Trochammina undulosa SCHIJFSMA

PLATE IV, *Figs. 3—4*

Trochammina undulosa SCHIJFSMA (1946, p. 39; Pl. 1, *Fig. 14*)

Remarks: The dorsal side is smooth and slightly convex, the periphery subacute, sutures curved backward, wall finely agglutinated, composed of fine grains of quartz with much siliceous cement producing a smooth surface. Diameter 0,32 to 0,35 mm.

Occurrence: SCHIJFSMA described this species from the Upper Cretaceous (Campanian) sediments in the Netherlands. This species occurs abundantly in the lower part of Qusseir shales in Abu Had section and somewhat higher in the Duwi section.

Trochammina webbi STELCK ET WALL

PLATE III, *Figs. 22—23*; PLATE VI, *Fig. 5*

Trochammina webbi STELCK ET WALL (1954, p. 33, pl. 2, *Fig. 11*)

Remarks: Test composed and slightly inflattened with lobate periphery, chambers gradually enlarging in size and subglobular in form, wall finely agglutinated with much quantity of cement.

Occurrence: This species was firstly described from the middle part of Kaskapau Formation (Upper Cretaceous), Alberta, Canada. It abundantly occurs in the most lower prat of the Qusseir shales (*Trochammina undulosa* Zone; Campanian) in the Abu Had and Duwi sections.

Trochammina wickendeni LOEBLICH

PLATE III, *Figs. 15—16*

Trochammina wickendeni LOEBLICH (1946, p. 138; Pl. 22, *Fig. 17*)

Remarks: This species is similar in size to *Trochammina albertensis* WICKENDEN from the Bearpaw shales of Canada, but it is not nearly so conical, as that. It has depressed sutures, few chambers and sharper periphery. Diameter 0,34 to 0,33 mm; thickness 0,06—0,07 mm.

Occurrence: Trochammina wickendeni was first recorded from the Upper Cretaceous Papper Formation, Oklahoma. It was found in the *Trochammina undulosa* Zone (Campanian) of the Abu Had and Duwi sections.

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Manuscript received, July 15, 1976

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EXPLANATION OF THE PLATES I—VII

PLATE I

1. *Proteonina complanata* FRANKE (40x)
2. *Glomospira irregularis* (GRZYBOWSKI) (40x)
3—4. *Glomospira serpens* (GRZYBOWSKY) (40x)
5—6. *Glomospirella gaultina* (BERTHELIN) (40x)
7—9. *Ammodiscus mangusi* (TAPPAN) (40x)
10—11. *Ammodiscus glabratus* CUSHMAN ET JARVIS (50x)
12. *Miliammina bisobscura* STELCK ET WALL (50x)
13—14. *Miliammina awunensis* TAPPAN (100x)
15—16. *Haplophragmoides rota* NAUSS (30x)
17—18. *Haplophragmoides calculus* CUSHMAN ET WATERS (60x)
19. *Haplophragmoides gracilis* SAID ET KENAWY (50x)

PLATE II

1. *Haplophragmoides glabra* CUSHMAN ET WATERS (36x)
2. *Haplophragmoides spiritensis* STELCK ET WALL (50x)
3. *Haplophragmoides sewellensis* OLSSON (50x)
4. *Haplophragmoides rugosa* CUSHMAN ET WATERS (50x)
5. *Haplophragmoides kirki* WICKENDEN (40x)
6. *Ammobaculites esnehensis* var. *nudus* NAKKADY (30x)
7. *Ammobaculites comprimatus* CUSHMAN ET APPLIN (50x)
8. *Ammobaculites stephensoni* CUSHMAN (50x)
9. *Ammobaculites advenus* CUSHMAN ET APPLIN (30x)
10. *Cribrostomoides cretacea* CUSHMAN ET GOUDKOFF (50x)
11—12. *Haplophragmium compressum* BEISSEL (50x)
13. *Ammobaculoides plummerae* LOEBLICH (30x)
14. *Lituola difformis* LAMARCK (30x)
15. *Ammobaculites agrestis* CUSHMAN ET APPLIN (30x)
16. *Lituola taylorensis* CUSHMAN ET WATERS (30x)

PLATE III

1. *Ammobaculites alexanderi* CUSHMAN (50x)
2. *Ammobaculites rowei* BANNER (50x)
3. *Ammobaculites colombiana* CUSHMAN et HEDBERG (30x)
4. *Lituola obscura* BARNARD ET BANNER (30x)
5—10. *Spiroplectammina bentonensis* CARMAN (100x)
11. *Spiroplectammina tenuis* GAUGER (100x)
12—13. *Trochammina texana* CUSHMAN ET WATERS (30x)
14. *Ammobaculites khargensis* NAKKADY ET TALAAT (50x)
15—16. *Trochammina wickendeni* LOEBLICH (50x)
17—18. *Trochammina albertensis* WICKENDEN (80x)
19—20. *Trochammina gyroides* CUSHMAN ET WATERS (50x)
21. *Trochammina rainwateri* CUSHMAN ET APPLIN (50x)
22—23. *Trochammina webbi* STELCK ET WALL (50x)

PLATE IV

1—2. *Trochammina altiformis* CUSHMAN ET RENZ (50x)
3—4. *Trochammina undulosa* SCHIJFSMA (50x)
5—6. *Trochammina borealis* KELLER (50x)
7—8. *Trochammina ruthven-murrayi* CUSHMAN ET RENZ (50x)
9—10. *Trochammina ribstonensis* WICKENDEN (50x)
11—12. *Glomospira serpens* (GRZYBOWSKI) (50x)
13. *Haplophragmoides rugosa* CUSHMAN ET WATERS (60x)
14. *Haplophragmoides glabra* CUSHMAN ET WATERS (120x)
15. *Haplophragmoides calculus* CUSHMAN ET WATERS (80x)

Plate V

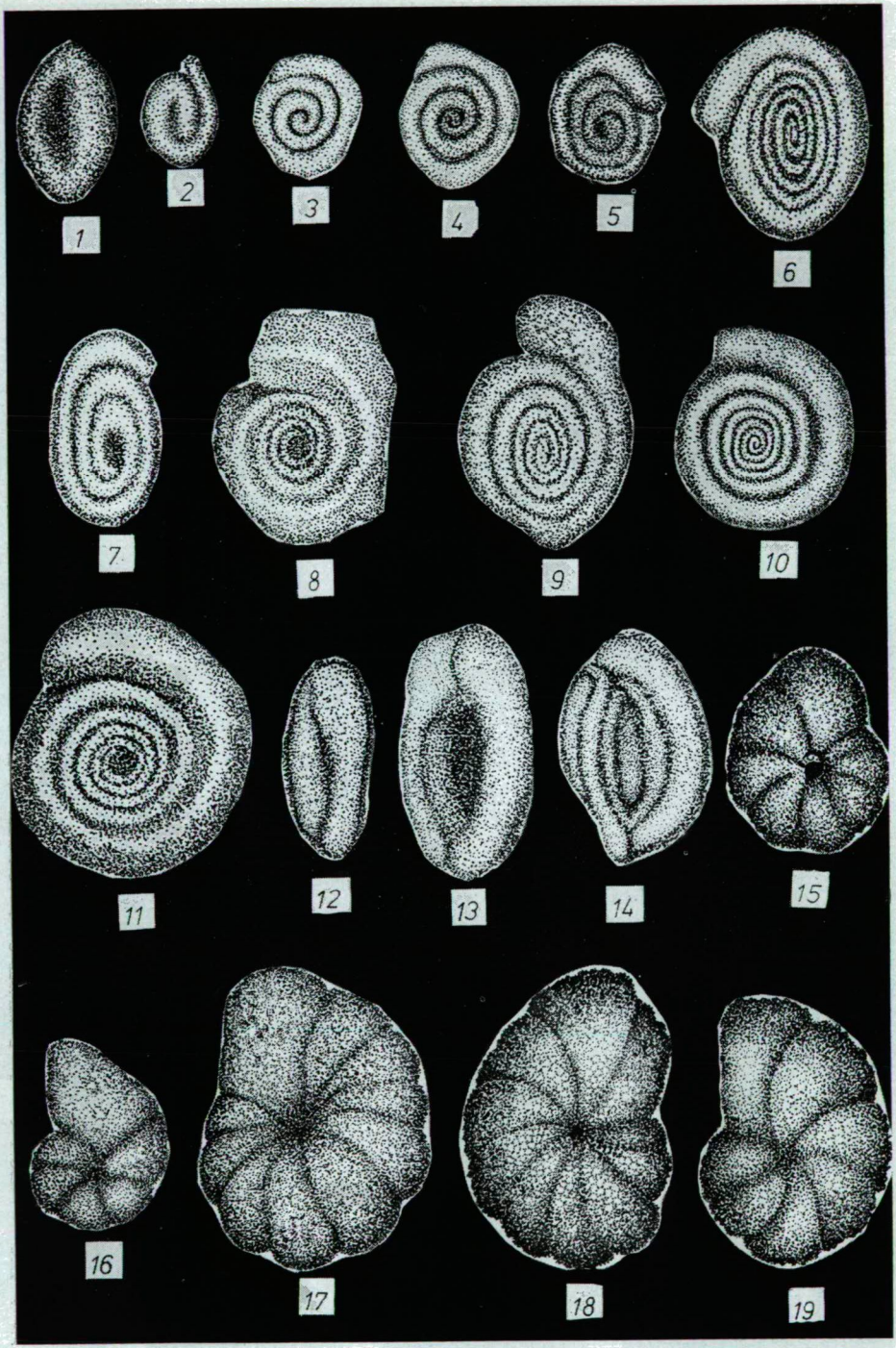
1. *Haplophragmoides glomeratoformis* Zaspyelova (100x)
2. *Haplophragmium compressum* Beissel (200x)
3. *Miliammina bisobscura* Stelck et Wall (225x)
4. *Ammobaculites khargensis* Nakkady et Talaat (60x)
5. *Haplophragmoides kirki* Wickenden (160x)

Plate VI

1. *Spiroplectammina bentonensis* Carman (200x)
2. *Ammobaculites advenus* Cushman et Applin — Equatorial section (100x)
3. *Haplophragmoides rota* Nauss — Equatorial section (100x)
4. *Haplophragmoides kirki* Wickenden — Equatorial section (200x)
5. *Haplophragmoides spiritensis* Stelck et Wall — Equatorial section (140x)

Plate VII

1. *Ammobaculites agrestis* Cushman et Applin — Equatorial section (100x)
2. *Haplophragmoides calculus* Cushman et Waters — Eqatorial section (200x)
3. *Trochammina webbi* Stelck et Wall — Equatorial section; 2N (100x)
4. *Ammobaculites colombiana* Cushman et Hedberg — Equatorial section (140x)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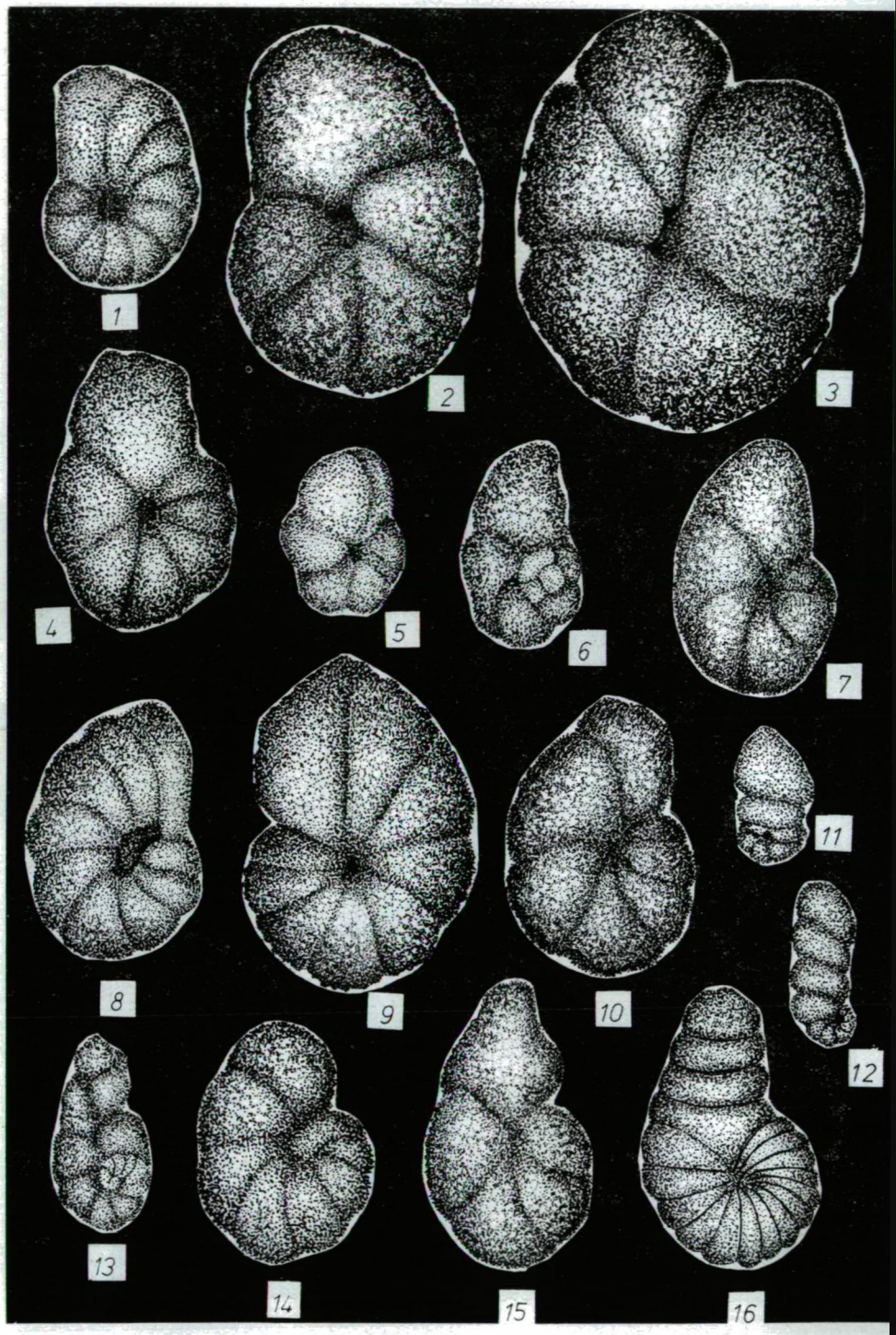
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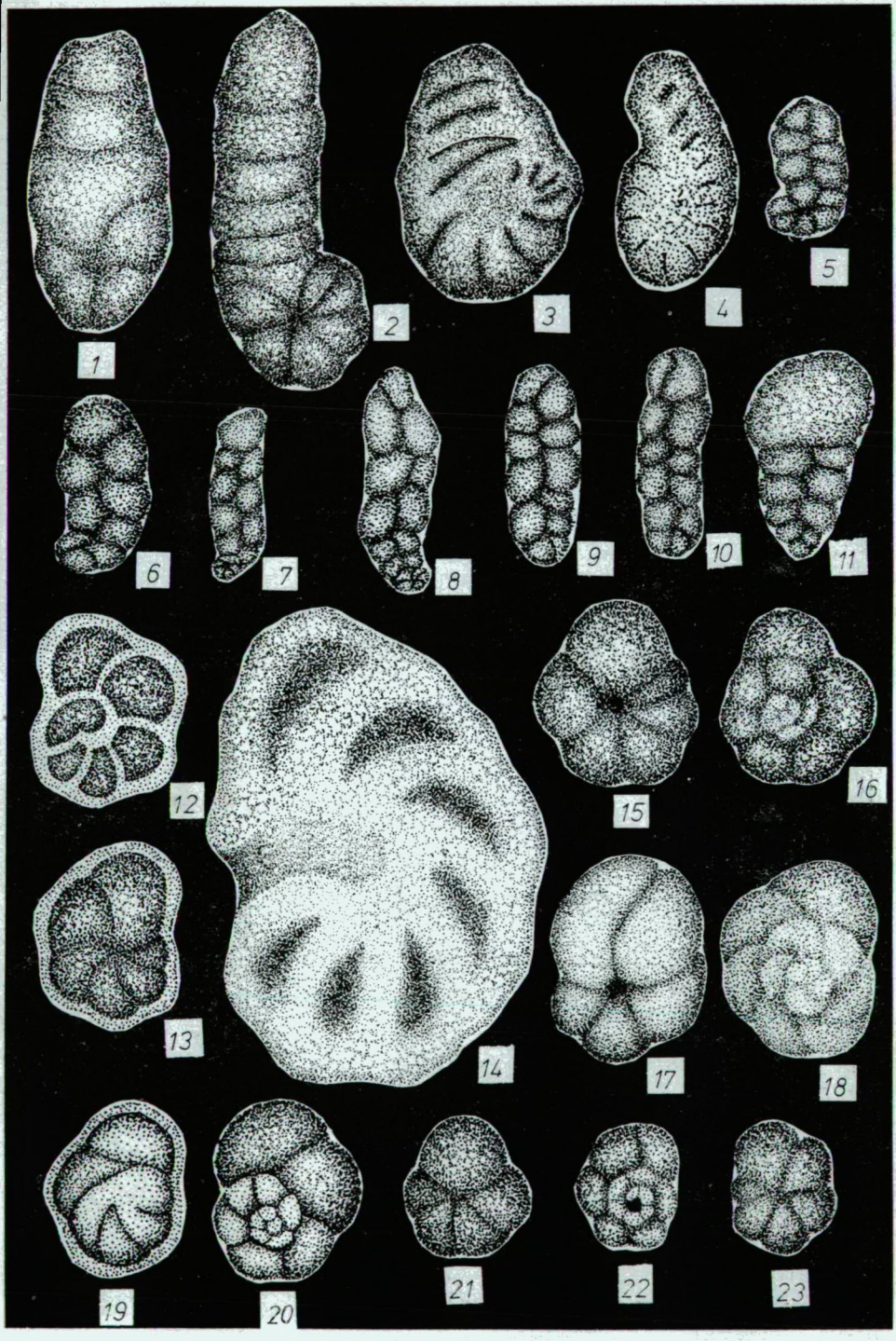
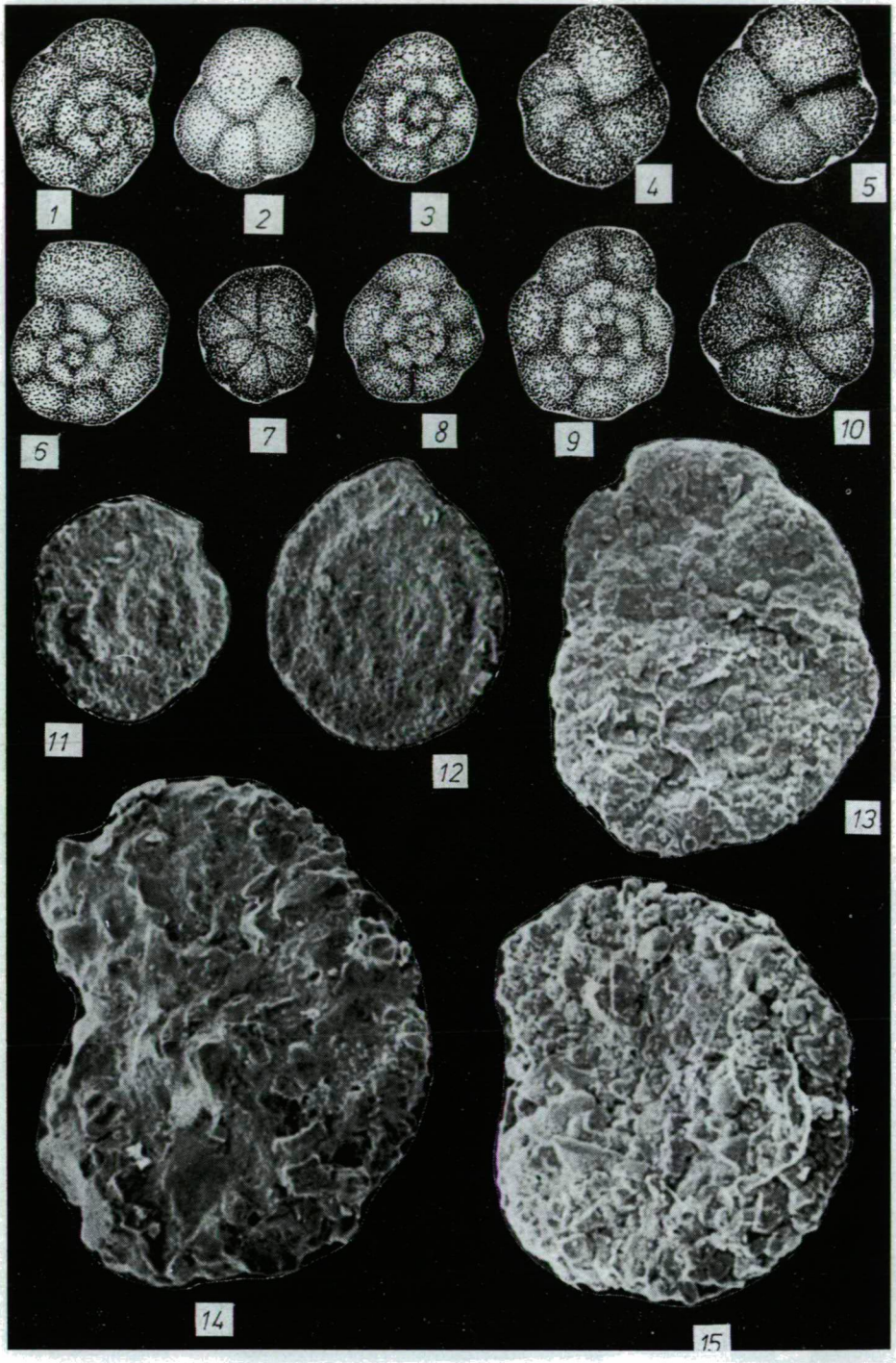
PLATE III

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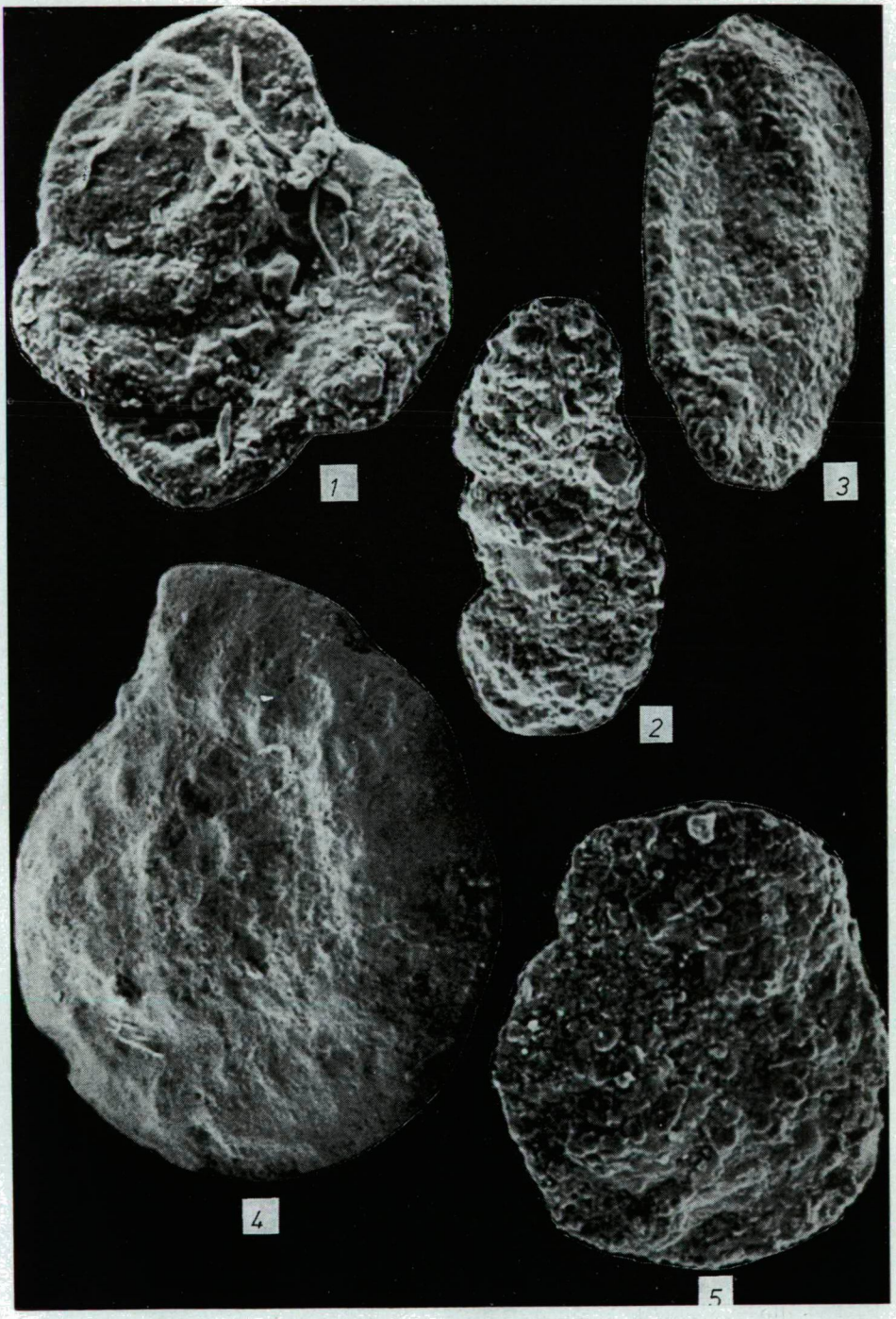
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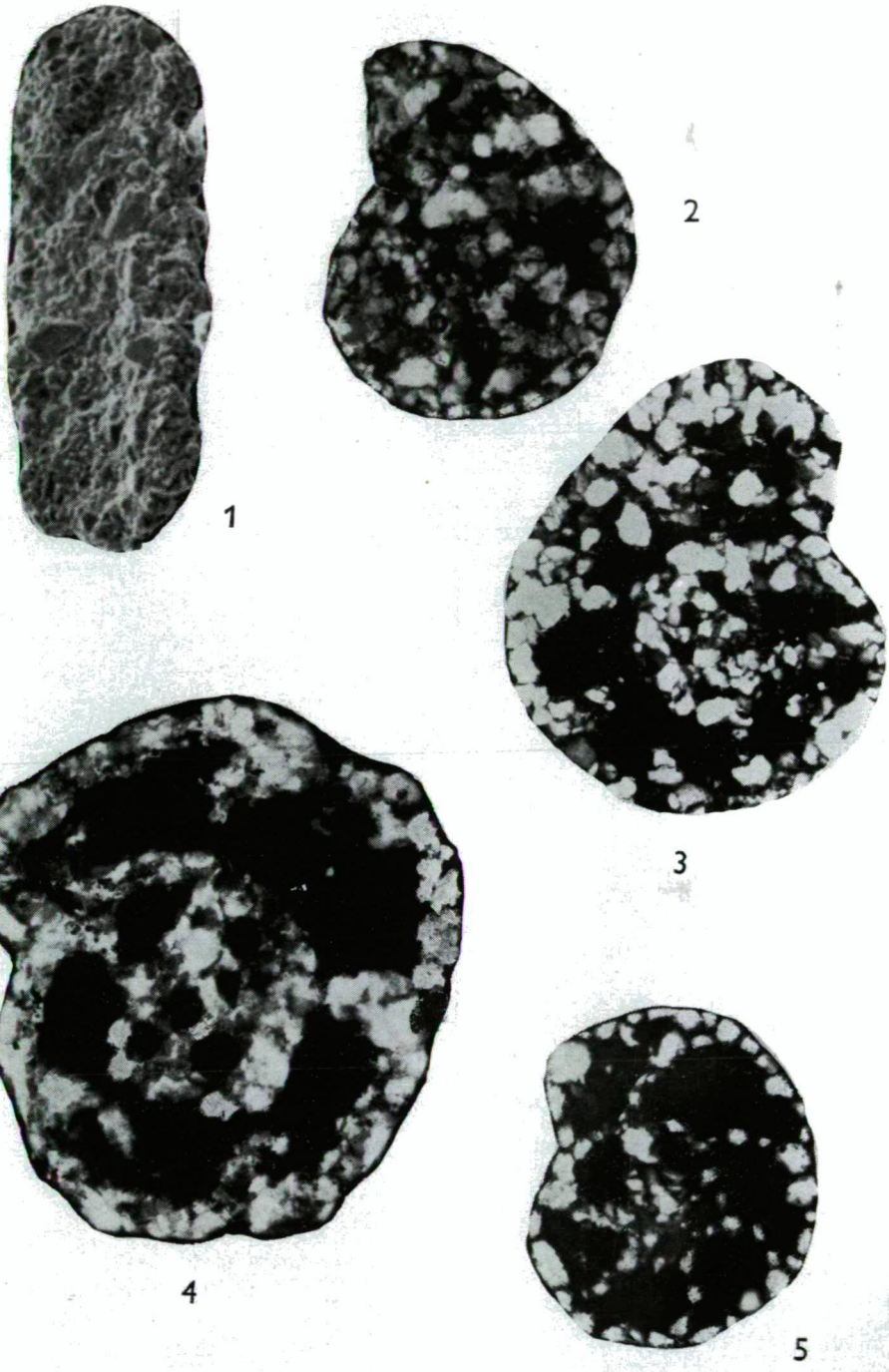

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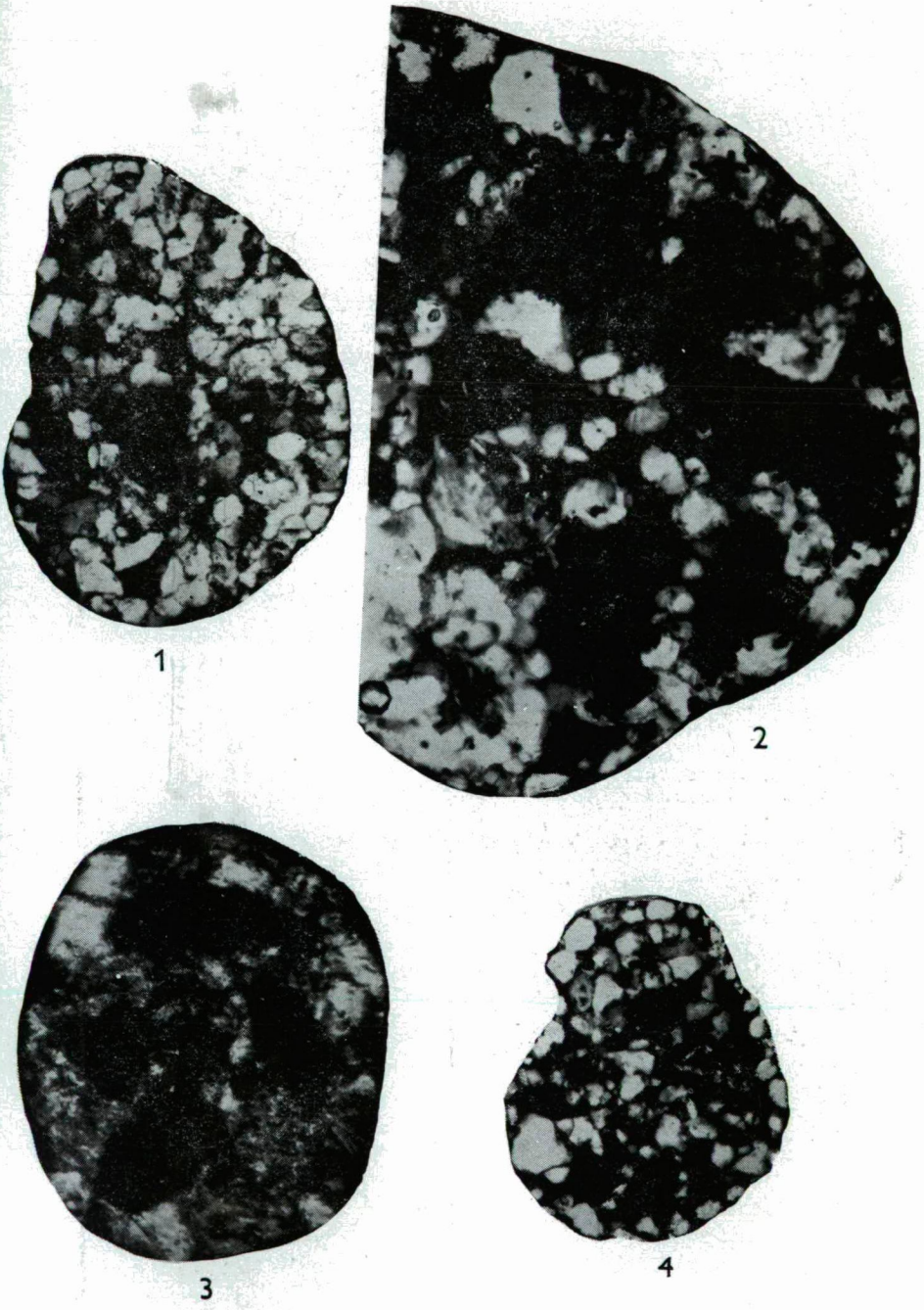

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